Effect of Hydro-therapy Versus Conventional Physical Therapy Protocol on Ankle Sprain Grade III in Elite Athletes

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ABSTRACT

Introduction: After knee injuries, ankle sprains rank as the second most frequent sport injuries, with approximately 85% of cases involving damage to the lateral ankle ligaments. These types of injuries are especially prevalent among elite athletes engaged in high-risk sports such as basketball and volleyball."
Purpose: To examine the impact of hydrotherapy as an initial rehabilitation method for elite athletes suffering from severe Grade III acute lateral lateral ankle sprains on either limb (RT or LT); on pain in comparison to the conventional physical therapy protocol that is conducted on land.
Methods: Thirty elite athletes aged between 18 and 30 with acute lateral grade III ankle sprains occurring within 1-7 days, predominantly engaged in overhead sports like volleyball and basketball, were included in the study. All participants were professional athletes. They were randomly divided into two groups for treatment: Group I (control) with 15 athletes following a conventional physical therapy protocol comprising therapeutic exercises, manual therapy, and land-based exercises with external support, and Group II (hydrotherapy) with 15 athletes undergoing hydro- training sessions. The pain intensity for each participant in both groups was assessed using the Visual Analog Scale (VAS).
Results: There was a significant interaction effect of Hydro- therapy on time for VAS ($p < 0.001$).
Conclusion: Comparatively, hydro- therapy proves more effective than the conventional physical therapy protocol in the early rehabilitation of acute lateral ankle sprains grade III on the injured side among elite professional athletes, leading to a significant reduction in pain intensity.
Keywords: Ankle sprain; Conventional Physical therapy; Hydro-therapy.

INTRODUCTION

Ankle sprains, the second most common sport injuries following knee injuries, predominantly affect the lateral ligaments due to inward twisting. These injuries are more common in female athletes, particularly in high-risk sports like basketball and volleyball. It is noteworthy that ankle injuries constitute a significant portion of orthopaedic emergency visits associated with sports (Hintermann et al., 2002). Despite this, many individuals do not seek medical attention following an ankle sprain, resulting in substantial time off from athletic activities (Fong et al., 2007).

Recurring ankle sprains are a prevalent concern, often leading to chronic ankle instability, which can exacerbate issues like pain, restricted physical activity, and an increased risk of conditions like osteoarthritis (Hintermann et al., 2002). Typical symptoms of acute lateral ankle sprains include localized pain, swelling, tenderness, bruising, instability, and in some cases, paresthesia due to nerve compression or injury (Roos et al., 2017).

Physiotherapy, integrating functional therapy (Doherty et al., 2017), manual techniques, therapeutic exercise (Green et al., 2001), taping (Mulligan, 2004), strength training, stability exercises, and sport-specific routines, has demonstrated efficacy compared to immobilization approaches during the inflammatory phase (Struijs & Kerkhoffs, 2010; Vuurberg et al., 2018). Semi-rigid casting in the initial stages of ankle sprain management has been linked with faster recovery and improved satisfaction (Primadhi et al., 2020). Surgical interventions are considered when conservative treatments fail to enhance stability, reduce pain, or restore function (Camacho et al., 2019).

Hydro- therapy, encompassing underwater exercises, offers a valuable medium for managing acute lateral ankle sprains by leveraging water's hydrostatic pressure to counteract gravitational effects (Pöyhönen et al., 2002). This approach can alleviate acute lateral and chronic pain during weight-bearing activities, expedite ligament recovery, improve stability, and enhance support for the affected limb (Bleakley et al., 2010; Kim et al., 2010). Hydrotherapy aids in early rehabilitation by leveraging water's buoyancy to reduce joint pressure, alleviate pain and swelling, and enhance strength, flexibility, and range of motion (Kim et al., 2010).

It also provides a low-impact environment for athletes, reducing stress on the joints and allowing them to safely perform exercises that may not be possible on land. Underwater exercises can improve balance and stability in athletes with ankle sprains by enhancing proprioception, leading to improved joint stability and better performance on land-based activities (Rivera et al., 2017).

Hydro- training has been lauded for its potential to mitigate severe acute lateral ankle sprains that hinder athletes' performance, impacting team morale and competition success. The positive outcomes of such interventions can potentially address both physical and psychological challenges linked to musculoskeletal injuries in athletes (Hubbard & Hicks-Little, 2008).

Psychological effects of these injuries include impacts on self-esteem and potential development of anxiety and depression (Fong et al., 2007). The timeline for returning to sports post-injury significantly influences an athlete's career trajectory, affecting their performance, achievements, and team dynamics. A rushed return to play without adequate recovery may heighten the risk of recurrent injuries, particularly concerning lateral ankle sprains (Wikstrom et al., 2020).

To the best of the author's knowledge, no existing studies have explored the efficacy of hydrotherapy in managing pain intensity in severe acute lateral ankle sprains grade III while maintaining a player's proprioception and balance. This research seeks to assist scholars focusing on early rehabilitation of Grade III ankle sprains by offering optimal treatment for a swift return to sporting activities with exceptional outcomes regarding the pain intensity levels. Hence, the primary objective of this examination is to assess the impact of a proposed hydrotherapy protocol as an early rehabilitative strategy for elite athletes experiencing Grade III acute lateral ankle sprains on pain intensity in comparison to the conventional physical therapy protocol.

MATERIALS AND METHODS

Study design:

A cohort of 30 participants, all professional athletes primarily engaged in overhead sports like volleyball and basketball, followed by individuals participating in high-contact sports such as football and rugby, were enlisted. These athletes presented with Grade III ankle sprains occurring within 1-7 days of injury, aged between 18 and 30 years. Through random allocation, the patients were divided into two treatment cohorts: Group I (control): 15 individuals underwent a tailored therapeutic exercise protocol, manual therapy, and land-based exercises with external assistance, while Group II (Hydrotherapy): 15 subjects underwent a comprehensive hydro-training protocol. The prescribed training lasted for four weeks, with pain assessments conducted three times: immediately post-injury, after implementing the training protocol at the end of week 4, and once more at the conclusion of week 6.

Inclusion criteria:

- Both genders with age ranges between 18-30 years old.
- BMI ranges between 18% - 25%.
- Patient with severe acute lateral ankle sprain (grade III) (either RT or LT limb) on the anatomical (LYNCH) grading system.
- Professional athletes that are currently playing in a club or tournament.

Exclusion criteria:

- Decision of surgery or casting.
- Sub-acute lateral (more than 7 days).
- High ankle sprain or pott’s fracture.
- Any previous musculoskeletal injury or surgery at this point or lower extremity.
- Contraindicated for Hydro- therapy according to Australian Physiotherapy Association guidelines (2021).

Assessment procedure:

- All patients were assessed by the same examiner (research assistant).
- All Patients were asked to fill the consent form (Appendix I).
- They were evaluated in accordance to pain before starting the treatment.

Treatment procedure:

All groups were treated by the same physical therapist.

Group I is set to undergo a rehabilitation protocol endorsed by the Clinical Practice Guidelines associated with the International Classification of Functioning, Disability, and Health, per the recommendations of the Academy of Orthopedic Physical Therapy within the American Physical Therapy Association

(Martin et al., 2021). On the other hand, Group II will undertake the hydro- therapy protocol established by Wilk and Joyner in 2014.

All individuals enrolled in the study were confirmed to have sustained grade III ankle sprains based on MRI findings (Harper, 2002), with exclusion criteria applied to patients displaying fractures upon X-ray examinations. The clinical assessment criteria encompassed positive results in tests such as the anterior drawer test or inversion stress test; individuals exhibiting positive outcomes in the squeeze test, external rotation test, or fibular translation test indicative of syndesmosis (high ankle sprain) as per the criteria established (Van Dijk et al.,1996) were not included in this research.

Visual Analog Scale (VAS) was used to measure the pain intensity

The control group underwent a conventional physical therapy rehabilitation protocol devised by Martin et al., contingent on the Clinical Practice Guidelines connected to the International Classification of Functioning, Disability, and Health endorsed by the Academy of Orthopedic Physical Therapy within the American Physical Therapy Association (Martin et al., 2021). The protocol encompassed several components which included initial immobilization using bracing and external support during the first week (Bleakley et al., 2008). Pain management utilized Low-Level Laser Therapy (De Moraes Prianti et al., 2018), complemented by occupational training (Martin et al., 2021), lymphatic drainage (Doherty et al., 2017), and a range of therapeutic exercises, such as active Range of Motion (ROM) movements like ankle pumps, active assisted eversion/inversion, stretching routines (Brotzman et al., 2011), and neuromuscular training through towel curls.

In the following week, the protocol featured exercises to maintain resistive ankle ROM utilizing resisted dorsiflexion/plantar-flexion, resisted inversion/eversion, postural re-education via toe raises and heel walking, balance enhancement activities including lunging on stable/unstable surfaces, step-ups/downs, and lateral step-ups/downs (Brotzman et al., 2011). Additionally, manual therapy techniques like joint mobilization, talar mobilization, and grade I;1st metatarso-phalangeal joint mobilization were integrated (Vuurberg et al., 2018), all tailored to the participants' pain levels and capabilities.

As the protocol progressed into the third and fourth weeks, exercises advanced to include Mini squats on unstable surfaces, Single-leg stance activities involving playing catch or working with the coach, and various Single-leg stance movements coupled with lower limb actions, all designed to enhance balance (Brotzman et al., 2011). Manual therapy in this phase featured deep friction massage, joint mobilization, talar mobilization, and grade II/III 1st metatarso-phalangeal joint mobilization techniques (Vuurberg et al., 2018), aimed at addressing the evolving needs of the participants.

The hydro- therapy exercise group commenced underwater training during the initial week, engaging in activities such as warm-up routines like Forward/backwards walking, Lateral walking, Lateral cross-over stepping, Straight-leg walking, and deep-water bicycle, along with stretching exercises targeting the posterior calf and tibialis anterior muscles (Wilk & Joyner, 2013).

Progressing into the second and third weeks, the exercise protocol evolved to focus on mobility training involving planter/dorsiflexion with modified resistance fins and strengthening exercises incorporating hip extension, double-leg squat, single-leg squat, forward lunge, hip abduction from standing, and lateral step-

ups utilizing elastic bands and underwater weights (Wilk & Joyner, 2013).

By the fourth week, participants in the hydro- therapy group were directed to follow the protocol outlined by Wilk and Joyner in 2013. This phase included proprioception training through activities such as forward lunges on a step with dumbbells, single-leg stance with ball tossing, and squats on a modified underwater balance board. Additionally, functional training elements were introduced, featuring exercises like vertical jumping and stationary running with a resistance cord.

3. Data analysis:

Statistical analysis was conducted using SPSS for Windows, version 26 (SPSS, Inc., Chicago, IL). Before final analysis, data were screened for normality assumption, homogeneity of variance, and presence of extreme scores and the p-value was set at < 0.05. This analysis was done as a pre-requisite for parametric testing of the analysis of differences.

Comparison between mean values of the different parameters in the two groups was performed using repeated measure MANOVA test to determine the significant differences between both groups at the two times testing interval (after 4 and 6 weeks of intervention).

Results

The flow chart of the screened and included patients is illustrated. Comparing the mean values of age, and BMI for all patients in the control and hydrotherapy groups using the independent sample *t*-test revealed that there were no significant differences between them in age ($p = 0.920$), and BMI ($p = 0.399$) (Table 1)(Fig.1).

Table 1: Descriptive statistics and the independent sample t-test for the mean values of age, and BMI of all patients in the Control and Hydro- therapy groups.

Variable	Mean ± SD		t-value	*p*-value	Sig.
	Control group N = 15	Hydrotherapy group N = 15			
Age (years)	23.80 ± 3.91	23.93 ± 3.26	-0.101	0.920	**NS**
BMI (kg/m^2)	22.373 ± 2.096	23.013 ± 1.996	-0.856	0.399	**NS**

*SD= Standard deviation, *t-value=t-statistic, *P-value=probability, *Sig. =Significance, *NS=non-significant.

The gender distribution comparison for all patients in the Control and Hydrotherapy groups using the Chi-square test revealed that there were no significant differences between groups ($p = 0.465$). Comparing the affected distribution for all patients in the Control and Hydrotherapy groups using the Chi-square test revealed that there were no significant differences between groups ($p = 0.715$) (Table 2).

Table 2: The frequency and the chi-squared test for comparison of gender and affected side distribution between the control and Hydrotherapy groups.

Variable		Group I (Control) N = 15	Group II (Hydrotherapy) N = 15	χ2 value	*p*-value	Sig
Gender	Males	6 (40 %)	7 (46.7 %)	0.533	0.465	NS
	Females	9 (60 %)	8 (53.3 %)			
Affected side	Rt	8 (53.3 %)	6 (40 %)	0.133	0.715	NS
	Lt	7 (46.7 %)	9 (60 %)			

*N= Number, *t-value=t-statistic, *P-value=probability, *Sig. =Significance, *NS=non-significant, Rt=right, Lt=left.

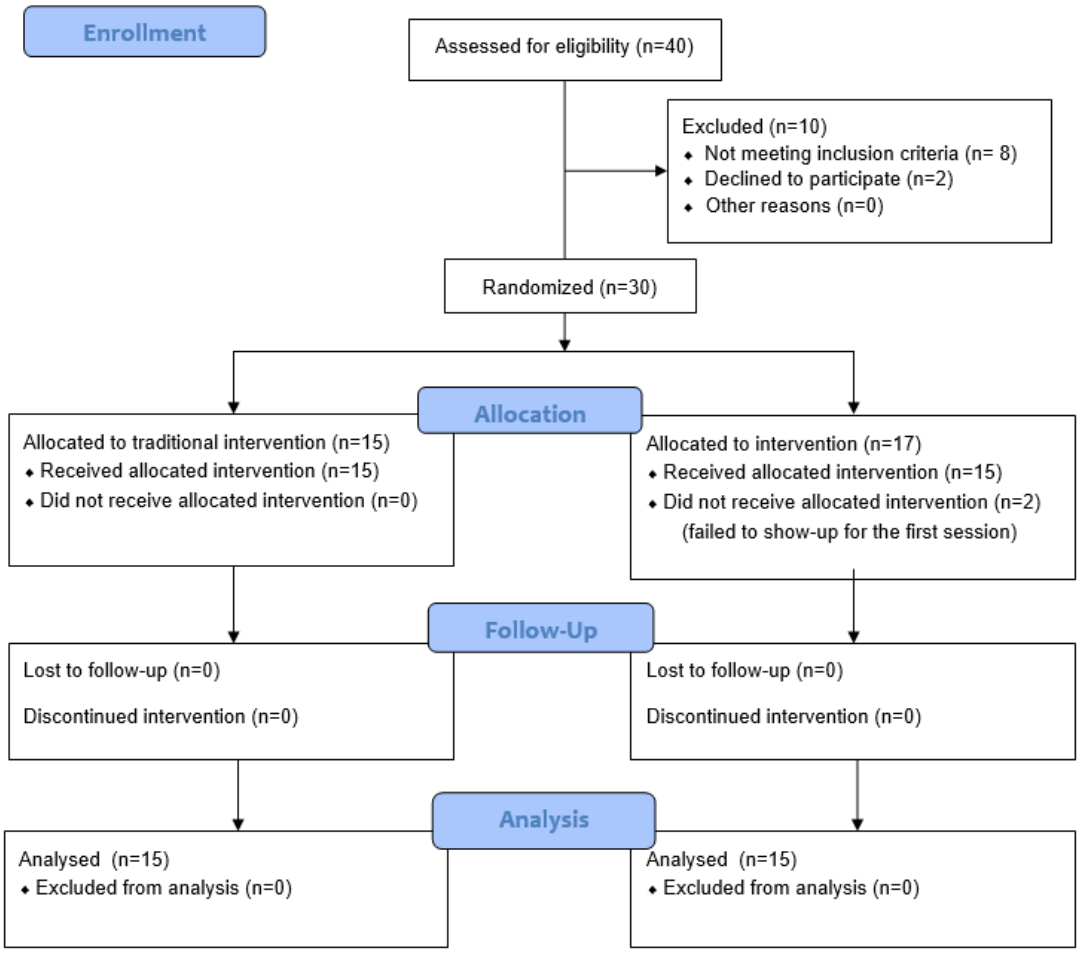

Figure 1: flow chart of screened and included patients

Repeated measure MANOVA was conducted to study the effect of rehabilitation timing on pain intensity in both groups. There was a significant interaction effect of Hydrotherapy and time for VAS ($p < 0.001$) (Table 3).

Table 3: Effect of timing of rehabilitation on all dependent variables

Repeated measure MANOVA		
Interaction effect (Group * time)		
VAS	F = 15.660	p < 0.001*
Effect of time		
VAS	F = 953.148	p < 0.001*

*VAS= Visual Analog Scale, *F-variable =F-Test statistics, *P-value=probability, *Sig. =Significance.

The effect of hydrotherapy training on pain intensity level showed a significant difference within and between-group comparisons ($p < 0.001$) (Figure 2).

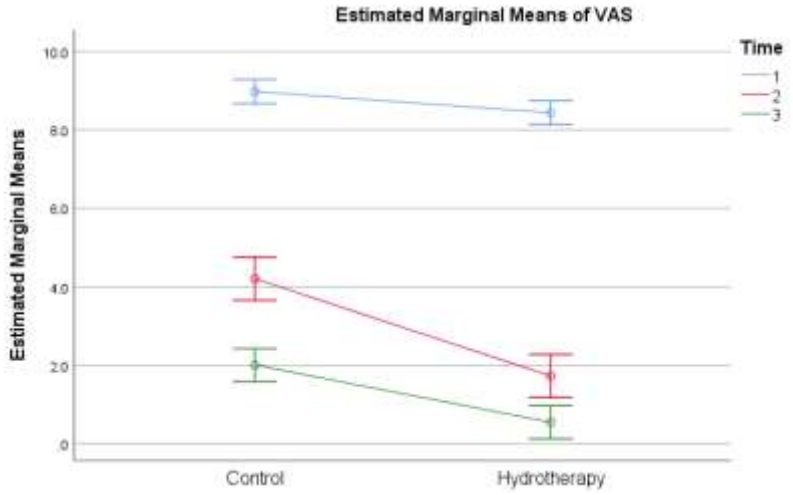

Figure 2: Estimated marginal mean values of pain intensity in both groups pre- and post-week 4 and 6

DISCUSSION

The results of this study illustrate the effectiveness of an accelerated early intervention strategy employing a four-week Hydro- therapy protocol for Grade III acute lateral ankle sprains among elite athletes.

A comparison with conventional physiotherapy interventions revealed notable advantages favoring the Hydro-therapy group in terms of ankle pain relief. Athletes adhering to the proposed Hydro-therapy protocol experienced lower levels of pain intensity when contrasted with land-based exercises utilized by the control group. These findings challenge the prevalent practices of immobilization, casting, and rigid tapping, advocating instead for functional treatments and therapeutic exercises to enhance athletic performance and mitigate reinjury risks (Bleakley et al., 2008) (Halabchi & Hassabi, 2020).

This research aligns with prior studies emphasizing the importance of addressing severe acute lateral ankle sprains in the realm of sports. Such injuries not only impact players' performance, team morale, and competitive success rates but also impose financial and emotional burdens on affected athletes (Hubbard & Hicks-Little, 2008).

Hydro- therapy displays a strong historical track record of efficacy and overall pain reduction, offering cardiovascular and musculoskeletal health benefits through water buoyancy. While showing no significant variance from other therapies for certain orthopedic conditions like osteoarthritis (OA) (Franco et al., 2017), these studies collectively reinforce the robust foundation supporting the superior outcomes indicated in this study.

The current study's results are consistent with a prior study concerning edema and pain management in specific musculoskeletal conditions related to the upright position during water running. The posture assumed during this activity mirrors walking and non-weight-bearing exercises in warm water within the Hydro-therapy context (Waller et al., 2009). Additionally, some research suggests that Hydro- therapy may offer pain relief for

individuals with musculoskeletal injuries compared to receiving no therapy. Nevertheless, other studies have not shown substantial pain reduction benefits from Hydro- therapy when compared to exercises performed on solid ground (Perraton et al., 2009).

When selecting the most suitable treatment for acute lateral ankle sprains, it is crucial to consider individual preferences and factors such as cost, accessibility, and available resources. Hydro- therapy may be particularly advantageous for individuals inclined towards water-based exercises or constrained in weight-bearing activities, while conventional physical therapy could present enhanced accessibility and cost-effectiveness for specific cases.

Acknowledging the limitations of this study is crucial. The relatively small sample size may have impacted the statistical power to identify subtle differences between groups. Furthermore, the study's treatment duration and follow-up period were confined to a specific timeframe, precluding an examination of the long-term effects of Hydro- therapy compared to conventional physical therapy. Future research incorporating larger sample sizes and extended follow-up periods is essential to offer a more comprehensive understanding of the relative effects of these treatment methodologies.

While this study underscores the positive outcomes of Hydro- therapy for Grade III ankle sprains, there exist unanswered questions warranting further investigation. Insights into the long-term effects of hydro- therapy on functional outcomes like return to sports and prevention of recurrent sprains need exploration. Additionally, exploring the synergies of combining hydro- therapy with complementary interventions such as manual therapy or neuromuscular training could further optimize rehabilitation outcomes for individuals with Grade III ankle sprains.

Addressing these research gaps not only enhances our understanding of the therapeutic potential of hydro- therapy but also paves the way for its refined application in clinical settings, contributing to improved patient outcomes and rehabilitation practices.

CONCLUSION

Hydro- therapy proves superior to conventional physical therapy protocol in the early rehabilitation of Grade III acute lateral ankle sprains in elite professional athletes regarding the pain.

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